100°C., altho the differences have a small percentage value, especially in the latter case.

Tables of vapor pressure over the lower range of temperatures are used daily by meteorologists and they will hardly feel satisfied with a systematic discordance of the kind we have pointed out, which doubtless results in part at least from extending each individual equation over the extreme range of temperature.

The constants composing equations (20) do not result from a least-square computation that includes the whole series of observations, but depend chiefly on observations at temperatures 0°, 80°, and 365°C. Nevertheless, the calculated values below 60°C., especially over the meteorological range of temperatures, are in closer agreement with the observations than in the case of equation (18). Between 100° and 200°C. equation (20) gives values that agree with the observations quite as well as those from (18). Above 200° C. the differences are somewhat in doubt, as Ekholm has given values at only a few points. On the whole, the results favor the adoption of equation (20) rather than (18).

The constants of the Clausius equation (37) depend likewise on only three observations, in fact, only on two, namely, at 0°, and the critical temperature 364.65°C. since at the third point used, the boiling point, the pressure by definition must be 760.00 millimeters and this does not rank as an observation. This equation, nevertheless, agrees very closely with the observations and with (20) below +30°C. Between this point and 100°C. it runs appreciably higher than either (20) or (18), both of which seem higher than the observations.

The vapor pressures in Broch's tables below 0°C. must be regarded as pressures over undercooled water and are too high to be applicable to vapor over ice. Between 0° and 30°C. the values run slightly smaller, nearly one-tenth of 1 per cent, than Ekholm, but near 100°C. the discrepancies are larger. The Landolt and Börnstein table, edition 1905, is seriously discordant with Ekholm below −30°, but between −30° and 100°C. the agreement is closer than in the case of the Broch tables. All values are smaller than Ekholm's.

The Thiesen–Scheel and the Holborn–Henning observations from 0° to 100° are also smaller than the values calculated by Ekholm's formulas. We must, therefore, conclude that for meteorological work the values calculated by equations (9) and (18) and adopted by Ekholm for his extended tables are systematically slightly too high, as shown by all the best observations.

Above 100° we find the three Ekholm equations all in close accord with each other and the observations, up to about 200°C. Beyond this point the equations give values systematically and increasingly higher than the observations up to 270°C., at which temperature the observations by Ramsay and Young terminate. A marked discontinuity in the trend of the curves is required at this point to join with the observations by Cailletet and Colardeau, and we are compelled to regard the observations themselves between 270° and 365° C. as much less exact than for the lower temperatures.

The observations by Holborn and Henning are probably more accurate than any others over the range of temperatures from 100° to 200°C, and it is of great interest to notice how closely the results agree with Regnault's values determined over half a century earlier. The values last found are systematically smaller than Henning's reduction of Regnault's observations, but the maximum difference, exprest in temperatures, amounts to only 0.02° at any point; that is, less than 0.06 per cent at 140°C., and still smaller percentages at higher temperatures.

A further point of great interest is revealed from a comparison, in fig. 3, of the trend of the curves for Ekholm's equations, and that representing Holborn and Henning's

2——2

work. These several curves follow each other from 80° to 200°C. in a very striking manner, and the inference is that if the Holborn and Henning values had been available to Ekholm his observed and calculated values would have shown a still closer agreement within this range of temperatures than is at present the case.

In conclusion it may be remarked that the systematic differences between observed and calculated values thruout what we may call the meteorological range of temperatures can not be accepted as entirely satisfactory. This, in some measure, must be caused by the effort to represent the pressures for the entire range of temperatures by one equation which is at least partly empirical. While, from the point of view of pure theoretical thermodynamics, only one equation is required, yet in the matter of practical application it is a question whether better results could not be secured by the use of two equations; one with constants, giving the best agreement with observations below 100°, due regard being paid below freezing to the difference between vapor over ice and over undercooled water, and the other equation adapted to conditions above 100°C. This alternative is, of course, preferable only on the assumption that the objections to the single equation can not be eliminated.

We have noticed a few errata in Ekholm's Table 7, namely: The differences in the last column should be, it seems, as follows:

At   0°, −.033   instead of −.031,
At 170°, +8.2   instead of +9.2,
At 340°, +2766. instead of +2834.

BIBLIOGRAPHY.

The titles of a few of the more important papers treating of the subject of vapor pressures are given in the following list:

1. Ekholm, Nils. Spannkraft des Gesättigten Wasserdampfes und und Eisdampfes. Arkiv för Matematik, Astronomi och Fysik; Utgifvet af K. Svenska Vetenskapsakademien, Stockholm (1908). Band 4, No. 29. Also: Ueber das Psychrometer. (Arkiv för Matematik, etc.). Band 4, No. 15. Upsala and Stockholm, 1908.

2. Regnault, M.V. Relation des Expériences. Memoires de l'Academie de l'Institute de France. Tome xxi. Paris, 1847. Huitiéme Memoire.

3. Broch, O. J. Tension de la vapour d'eau. Travaux et Mem. du Bureau Int. des Poids et Measures. Tome I. Paris, 1881. II.

4. Juhlin, Julius. Bestämning af Vattenagans Maximi-Spänstighet. Bihang til K. Svenska Vet. Akad. Handlingar. Band 17, Afd. I. Stockholm, 1891.

5. Marvin, C. F. Annual Report, Chief Signal Officer, War Department, 1891. Appendix No. 10. pp. 351—383. Washington, 1892.

6. Thiesen, M. and Scheel, K. Bestimmung der Spannkraft des Gesättigten Wasserdampfes. Bei Temperaturen Zwischen −12° und +25°. Insbesondere bei 0°. Wissenschaftliche Abhandlungen der Physikalisch-Technischen Reichsanstalt. Band III. Berlin, 1900. Also: Ueber die Spannung des gesättigten Wasserdampfes bei Temperaturen unter 0°. Annalen der Physik und Chemie (Leipzig), 1899. No 3.

7. Wiebe, H. F. Ueber die Spannkrafte des Wasserdampfes in Temperaturen zwischen 82 und 100 Grad. Zeitschrift für Instrumentenkunde. XIII Jahrgang. 1893. pp. 329-335. (Mittheilungen aus dem gesammten Gebiete der wissenschaftlichen Technik,—Abtheilung der Physikalisch-Technischen Reichsanstalt. Berlin.

8. Landolt-Börnstein. Physikalisch-Chemische Tabellen. Berlin, 1905.

9. Ramsay and Young. Phil. Trans. 183 A. 1892.

10. Battelli. Memorie della R. Accademia delle Scienze di Torino, Ser. seconda. Tomo XLIII, p. 63-98 (1893).

11. Cailletet and Colardeau. Journal de Physique. Ser. II. Vol. 10. p. 333 (1891).

12. Holborn L. and Henning F. Ueber das Platinthermometer und den Sättigungsdruck des Wasserdampfes zwischen 50° und 200°. (Mitteilung aus der Physikalisch-Technischen Reichsanstalt). Annalen der Physik. 4te Folge. Band 26. No. 10, pp. 833-883.

NOTES FROM THE WEATHER BUREAU LIBRARY.

By C. FITZHUGH TALMAN, Librarian.

INTERNATIONAL COMMISSION ON SCIENTIFIC AERONAUTICS.

H. H. the Prince of Monaco, who is an honorary member of the International Commission on Scientific Aeronautics, has

invited the commission to hold its next triennial meeting at Monaco April 1 of this year. It is proposed to hold the sessions in the rooms of the Oceanographic Museum. The last meeting was held at Milan in 1906.

This commission suffers under a somewhat misleading name, as it is not especially concerned with aeronautics—i. e., the navigation of the air—but has for its sphere the whole subject of upper air meteorology. Inasmuch as the term "aerology" is now quite generally applied to this branch of meteorology, the writer of these notes ventures to suggest that the commission ought to be renamed "International Aerological Commission;" especially as there exists another international organization for the discussion of purely aeronautical questions; viz, the Commission Permanente Internationale d'Aéronautique.

This commission—i. e., the one devoted to "aerology"—has a membership of 55, and is the largest of all the commissions on special subjects appointed by the International Meteorological Committee. Its president is Prof. H. Hergesell, director of the Meteorological Service of Alsace-Lorraine.

INTERNATIONAL COMMISSION ON DAILY WEATHER REPORTS FOR THE GLOBE.

Another meteorological commission is to meet at Monaco in April; viz, the commission appointed at the last Paris meeting of the International Meteorological Committee to consider Teisserenc de Bort's plan of securing prompt reports, day by day, from about 30 selected stations in various parts of the globe, and the suggestion of Hildebrandsson that observatories be established at the "centers of action" of the atmosphere. This commission will begin its sessions just after those of the Commission on Scientific Aeronautics, viz, April 5, 1909. The adoption of the project of MM. Teisserenc de Bort and Hildebrandsson would enable the central office of each national weather service to keep en rapport with current meteorological conditions in other parts of the globe, and especially in those regions where the phenomena of the atmospheric circulation are believed to be of the greatest significance to the weather of the world at large. So far as the Weather Bureau is concerned, it would facilitate the enlargement and improvement of our synoptic weather map of the Northern Hemisphere, now made every day at Washington from telegraphic reports.

The members of this commission are: Teisserenc de Bort (president), Hildebrandsson (secretary), Hergesell, Deslandres, Hellmann, Lyons, Shaw, and Walker.

METEOROLOGICAL APPOINTMENT IN BELGIUM.

It is announced that J. Vincent has been appointed director of the meteorological service of the Royal Observatory of Belgium—i. e., of the Belgian national weather service—to succeed the late Albert Lancaster. M. Vincent has been prominently connected with the Belgian service for many years, and has been director ad interim since the death of M. Lancaster; hence his appointment to the directorship was in the natural order of events.

A COURSE IN METEOROLOGY FOR BALLOONISTS.

A five-hour course in meteorology for balloonists and others interested in aeronautics, covering the months of January and February, has been established at Cologne under the auspices of the aeronautical club of that city. The lectures are given at the Handelhochschule, by Doctor Polis, director of the meteorological observatory of Aix-la-Chapelle.

HOMAGE TO PROFESSOR HANN.

Meteorologists all over the world unite this year in doing honor to Hofrat Prof. Dr. Julius Hann, of Vienna, who completes his 70th year on March 23. At the instance of Prof. Wilhelm Trabert, the photographs of prominent meteorologists of all countries have been collected at Vienna, and will be presented to Professor Hann on his birthday.

DR. PAUL BERGHOLZ, 1845-1909.

Dr. Paul Bergholz, director of the meteorological observatory at Bremen, died January 3, 1909. Doctor Bergholz took charge of the second-order station at Bremen in 1889, caused it to be raised to the rank of an observatory the following year, and thereafter, up to the time of his death, carried on the observations that have been published in such elaborate detail as a separate annual volume, for Bremen, of the "Deutsches meteorologisches Jahrbuch." He also collected and published several early series of observations at Bremen, extending back to the year 1803.

Other publications by Doctor Bergholz related to tropical hurricanes, including a substantial volume, "Die Orkane des ferne Ostens" ("The hurricanes of the far east"), based on the first edition of Algué's well-known treatise on that subject.

OFFICERS OF THE ROYAL METEOROLOGICAL SOCIETY FOR 1909.

At the annual meeting of the Royal Meteorological Society on January 20, the following officers and members of the council were elected for the ensuing year:

President, Lieut.-Col. H. Mellish; Vice-Presidents, Mr. W. W. Bryant, Mr. W. H. Dines, F. R. S., Commander M. W. Campbell Hepworth, C. B., Dr. H. R. Mill; treasurer, Dr. C. Theodore Williams; secretaries, Mr. F. C. Bayard, Commander W. F. Caborne, C. B.; foreign secretary, Dr. R. H. Scott, F. R. S.; council, Messrs. R. Bentley, F. J. Brodie, C. J. P. Cave, Dr. H. N. Dickson, F. Druce, E. Gold, R. Inwards, B. Latham, R. G. K. Lempfert, Col. H. E. Rawson, C. B., Capt. R. C. Warden, and Capt. D. Wilson-Barker.

AEROLOGICAL STATIONS OF THE WORLD.

The Wiener Luftschiffer Zeitung for February 1, 1909, publishes a complete list of the upper air observations made on the "international days" during the first half of the year 1908. From this list we learn that observations with kites or balloons (or both) were made more or less regularly at the following places:

Trappes, France; Uccle, Belgium; DeBilt (near Utrecht), Holland; Pyrton Hill, Petersfield, Brighton, Glossop (near Manchester), England; Pavia, Italy; Guadalajara, Spain; Zürich, Switzerland; Strassburg, Frankfort a M., Hamburg, Lindenberg, Munich, Friedrichshafen (the kite station on Lake Constance), Germany; Vienna, Austria; Pavlovsk, Kasan, Koutchino, Ekaterinburg, Nijni Olchedaev, Tiflis, Baku, Kovno, Russia; Helwan, Egypt; Blue Hill (Mass.), Mount Weather (Va.), United States.

The above is not a complete list of the aerological stations of the world, but will convey some idea of the extensive scale upon which the campaign of upper air research is now being conducted.

SUMMER AND WINTER VERTICAL TEMPERATURE GRADIENTS.

By W. J. HUMPHREYS, Professor of Meteorological Physics.
Dated Mount Weather, February, 1909.

In my article on the vertical temperature gradients of the atmosphere, Vol. II, No. 1, of the Mount Weather Bulletin, I state that the effect of change of season on this gradient causes it to be greatest in winter and least during the summer, and that this condition is best seen at a considerable elevation, since in the turbulent region next the earth storms and other temporary results mask those due to seasonal change.

The gradients of the lower atmosphere are so frequently at variance with the above statement in regard to the seasonal changes that it seems desirable to test it by a large number of direct observations. I have, therefore, brought together in Table 1 all the published summer and winter gradients between 3,000 and 8,000 meters elevation obtained since 1904 with sounding balloons at five different stations.

The 3,000-meter level is just above the lower turbulent region, in which to measure the temperature gradient is akin